

Application Number 10/650,121
Response to Office Action mailed August 3, 2007

AMENDMENTS TO THE SPECIFICATION

Please amend the Applicant's Specification as follows.

Please replace paragraphs [0018]-[0022] with the following replacement paragraphs:

[0018] Feature-kernel selection module 16 may operate independently of SVM classifier 18 to simultaneously select a reduced input set 22, comprising input features for linear classifiers or kernel functions for nonlinear classifiers, and generate a linear or nonlinear SVM classifier 18 based on input data 12 while utilizing the reduced input set 22 of input features or reduced kernel functions [[22]]. In general, feature-kernel selection module 16 defines a linear programming formulation of SVM classifier 18, solves an exterior penalty function of a dual of the linear programming formulation to produce a solution to the SVM classifier, and selects an input set for the SVM classifier based on the solution. The input set includes selected features in the case of a linear classifier, or selected kernel functions in the case of a nonlinear classifier.

[0019] SVM classifier 18 generates classification output 20, which classifies input data 12 into two classes based on the reduced input set 22 of input features or kernel functions [[22]] generated by feature-kernel selection module 16. SVM classifier 18 may be based on a linear or nonlinear SVM. In the case of a linear SVM, feature-kernel selection module 16 generates a reduced set of input features. In the case of a nonlinear SVM, feature-kernel selection module 16 generates a reduced set of kernel functions. Classification output 20 may be useful in a variety of applications including, for example, fraud detection, credit evaluation, gene expression, and medical diagnosis and prognosis.

[0020] Feature-kernel selection module 16 selects a small subset of input features [[22]] or a small number of kernel functions from a large set of input data 12 to define SVM classifier 18. Feature-kernel selection module 16 may be implemented with a linear equation solver, without the need for specialized and costly linear programming packages. In addition, as discussed above, feature-kernel selection module 16 may be effective in suppressing input features for linear SVM classifiers and suppressing kernel functions for nonlinear SVM classifiers. In operation, feature-kernel selection module 16 applies a fast Newton method to solve an exterior

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penalty function for a dual of a linear programming formulation of SVM classifier 18 to solve the SVM classifier function.

[0021] Feature-kernel selection module 16 applies the Newton method to the dual of a 1-norm linear programming formulation that is known to produce very sparse solutions. By solving the exterior penalty function of the dual of the 1-norm linear programming formulation, for a finite value of the penalty parameter, feature-kernel selection module 16 produces an exact least 2-norm solution to the SVM classifier 18. The resultant separating hyperplane defined by SVM classifier 18 relies on a reduced set of input features [[22]]. In the case of a nonlinear SVM classifier, few kernel functions are needed.

[0022] SVM classifier 18 applies the input features (or kernel functions) [[22]] produced by feature-kernel selection module 16 to generate classification output 20 for the larger set of input data 12. Hence, feature-kernel selection module 16 applies a fast Newton method that suppresses input features to define a linear SVM classifier that depends on very few input features or a nonlinear classifier with few kernel functions. Notably, feature-kernel selection module 16 enables formulation of an SVM classifier 18 that is capable of handling classification problems in very high dimensional spaces using only a linear equation solver, thereby eliminating the need for complex and costly linear programming packages. The SVM classifier generated with the resulting input features can be referred to as a Newton Linear Programming Support Vector Machine (NLPSVM).

Please replace paragraph [0024] with the following replacement paragraph:

[0024] An exterior penalty function solver 28 solves an exterior penalty function of the dual of the linear programming formulation to solve the SVM classifier function. Based on the solution of the exterior penalty function, a feature-kernel selection generator 30 processes input data 12 to suppress redundant features or kernels and thereby generate a ~~set of reduced~~ input set 22 of feature or kernel coefficients [[22]] for use by SVM classifier 18. The structural representation of feature-kernel selection module 16 as a set of functional modules in FIG. 2 is for purposes of illustration, and should not be considered limiting of the invention as broadly embodied and described herein.